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## Background

Since the EU-ban of antimicrobial growth promoters the interest in alternatives to support the gut microbiota is increasing. A well-known approach is the use of probiotics. Most known probiotics however, are not able to survive applied technology in feed production, e.g. heat administration. One way to overcome these problems is the use of spore forming probiotics, particularly *Bacillus subtilis*. For practical use compatibility with organic acids, coccidiostats and therapeutic antibiotics is important too.



## Mode of action

For the use of *B. subtilis* in pig and poultry feed are various modes of action underlying. *B. subtilis* consumes oxygen in the digestive tract but produces also various enzymes such as catalase and subtilisin. As a result the environmental conditions for beneficial bacteria such as lactic acid bacteria improve. These colonize the intestinal wall and

block the binding sites for pathogenic bacteria, a process called competitive inhibition. In addition, lactobacilli produce lactic acid, which acts against salmonella, *E. coli*, campylobacter and clostridia (Hosoi *et al.* 2000).

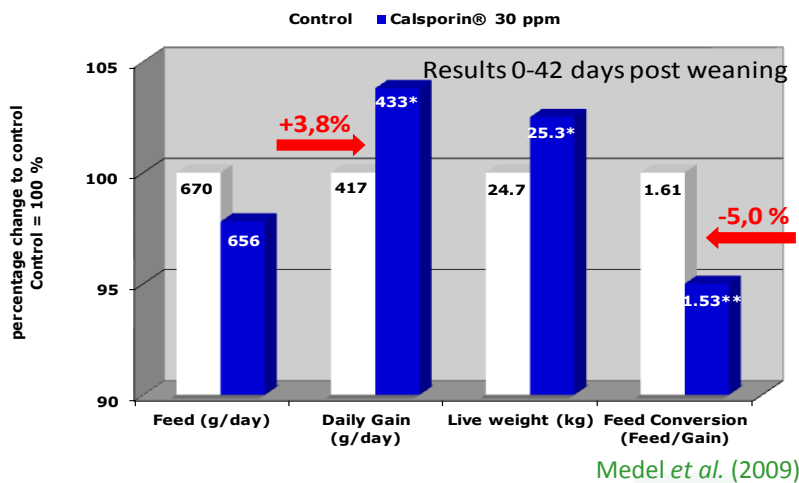
## Results in piglets

EU efficacy studies illustrated that *B. subtilis* C-3102 significantly improved daily gain and feed conversion compared to a control treatment (Medel *et al.* 2009). In a challenge trial *B. subtilis* C-3102 was compared with an antibiotic treatment after challenging piglets with *E. coli* K88 on gut microbiota. Antibiotic lowered numerically the amount of *E. coli*, but at the same time also the amount of lactic acid bacteria. *B. subtilis* C-3102 also numerically lowered of *E. coli* but increased significantly lactic acid bacteria. Both antibiotic and *B. subtilis* C-3102 showed improved faeces score and lower mortality in comparison to control group (Bhandari 2008).

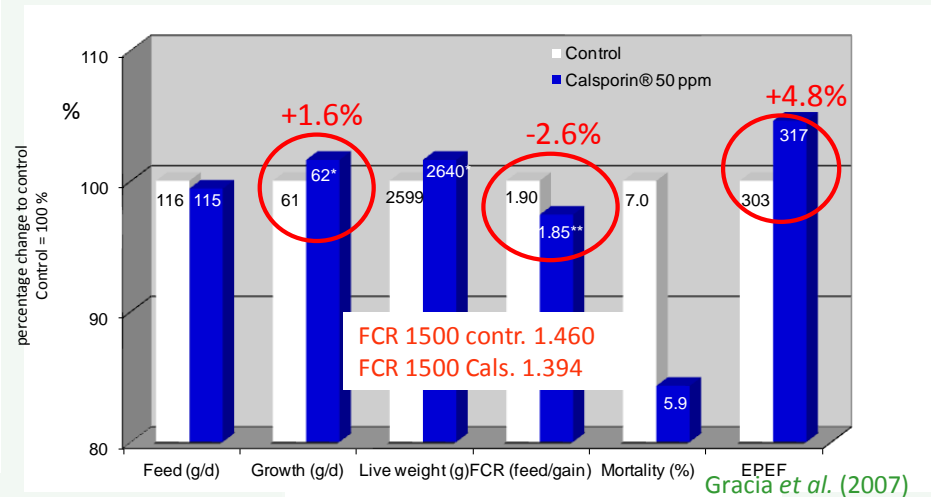
## Results in broiler

EU efficacy studies showed that *B. subtilis* C-3102 significantly improved daily gain and feed conversion and economy compared to a control treatment (Gracia *et al.* 2007). These results are confirmed in practical trials with broilers all over Europe (in total 9 trials in 5 different countries with in total approximately 2.000.000 birds). A reduction of positive birds for campylobacter infections was reported from 100% in control to 40% of birds fed *B. subtilis* and when *B. subtilis* was fed longer infection rate was reduced to only 16% positive birds (Maruta *et al.* 1996).

Summarized results of EU registration trials



Summarized results of EU registration trials



### *B. subtilis* C-3102 and Enteric pathogen protection

#### Mucosal microbiota (log CFU/g tissue)

	Control	Antibiotics	Calsporin
<i>E. coli</i>			
Ileum	7,20	6,61	6,70
Colon	7,57	6,90	6,79
Lactic acid bacteria			
Ileum	7,88	6,63	8,79
Colon	9,67 <sup>ab</sup>	7,87 <sup>a</sup>	10,02 <sup>b</sup>

a, b: p<0.05

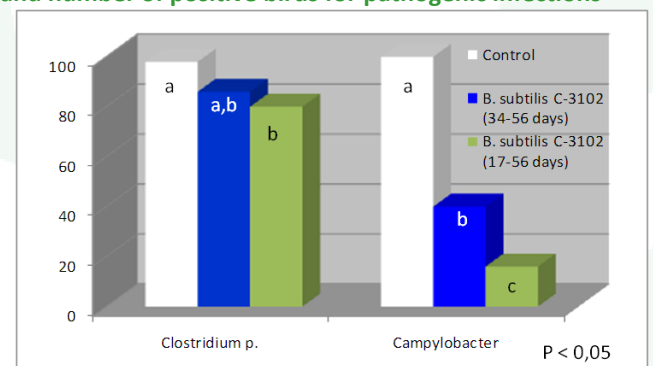
#### Disease severity

	Control	Antibiotics	Calsporin
Fecal score			
6 hours postinfection	1,55	1,33	0,89
24 hours postinfection	1,31 <sup>a</sup>	0,47 <sup>b</sup>	0,34 <sup>b</sup>
72 hours postinfection	1,39	1,13	0,83
Mortality	6/18 <sup>a</sup>	0/18 <sup>b</sup>	2/18 <sup>b</sup>

a, b: p<0.05

Bhandari *et al.* (2008)

### *B. subtilis* C-3102 and number of positive birds for pathogenic infections



## Conclusion / Summary

The use of *Bacillus subtilis* C-3102 has shown positive effects in reducing pathogenic pressure in the gut in different studies in pigs and poultry. Probiotics in this form can survive heat stress during pelleting or expansions processes and are compatible with feed agents like organic acids, coccidiostats and therapeutic antibiotics, which are

widely used in monogastric compound diets. Summarizing *Bacillus subtilis* C-3102 can be successfully used in pig and poultry diets to ensure good gut health and prevent overload of bacteria which can cause either diseases for the animal as well as zoonoses for humans after consumption of meat.